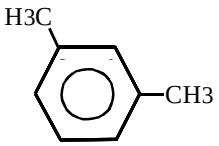
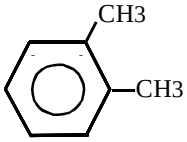
XYLENES (Isomers and Mixture)

Xylenes (isomers and mixture) are federal hazardous air pollutants and were identified as toxic air contaminants in April 1993 under AB 2728.

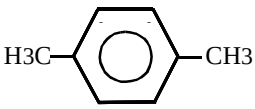
Molecular Formula: C_8H_{10}



m-Xylene



o-Xylene



p-Xylene

This fact sheet refers to the mixture of m-xylene, o-xylene, and p-xylene (mixed xylenes). Mixed xylenes are colorless liquids that are insoluble in water and miscible with alcohol, ether, and many other organic solvents. The commercial mixed xylenes are composed of the three isomers, with the m- and p- isomers predominating. For particular purposes, the m-, o-, or p-isomer may be separated. They are insoluble in water (HSDB, 1991; Sax, 1987).

Physical Properties of Mixed Xylenes

Synonyms: m-xylene: 1,3-xylene; 1,3-dimethylbenzene; m-dimethylbenzene
Synonyms: o-xylene: 1,2-dimethylbenzene; o-dimethylbenzene; o-methyltoluene; 1,2-xylene
Synonyms: p-xylene: 1,4-xylene; p-dimethylbenzene; 1,4-dimethylbenzene; p-methyl-toluene

	m-Xylene	o-Xylene	p-Xylene
CAS Registry Number	108-38-3	95-47-6	106-42-3
Molecular Weight:	106.18	106.18	106.18
Boiling Point:	139.3 °C	144.4 °C	137 - 138 °C
Melting Point:	-47.4 °C	-25.2 °C	13 - 14 °C
Flash Point:	77 °F (closed cup)	62.6 °F	77 °F (closed cup)
Vapor Density:	3.66 (air = 1)		3.66 (air = 1)
Vapor Pressure:	8.3 mm Hg at 25 °C	6.6 mm Hg at 25 °C	8.7 mm Hg at 25 °C
Density/Specific Gravity:	0.8684 at 15/4 °C (water = 1)	0.880 at 20/4 °C (water = 1)	0.86104 at 20/4 °C (water = 1)
Log Octanol/Water Partition Coefficient:	3.20	3.12	3.15
Conversion Factor:	1 ppm = 4.3 mg/m^3	1 ppm = 4.3 mg/m^3	1 ppm = 4.3 mg/m^3

(Howard, 1990; Merck, 1989; Sax, 1987; Sax, 1989)

SOURCES AND EMISSIONS

A. Sources

Emissions of mixed xylenes have been detected from petroleum refining, motor vehicles, residential wood-burning stoves and fireplaces. Mixed xylenes are used as chemical intermediates, as solvents, in aviation fuel, and in household products such as aerosol paints and lacquers (Howard, 1990).

Xylene is registered as an insecticide. Only one product containing xylene is still registered, although use of this product has been suspended since 1993. It was registered for use on fruit, vegetable and grain crops, on ornamental lawns, gardens and plants. It may be applied to dogs, and animal dwellings as well as around houses and farm buildings (DPR, 1996).

The licensing and regulation of pesticides for sale and use in California are the responsibility of the Department of Pesticide Regulation (DPR). Information presented in this fact sheet regarding the permitted pesticidal uses of xylene has been collected from pesticide labels registered for use in California and from DPR's pesticide databases. This information reflects pesticide use and permitted uses in California as of October 15, 1996. For further information regarding the pesticidal uses of this compound, please contact the Pesticide Registration Branch of DPR (DPR, 1996).

The primary stationary sources that have reported emissions of m-, o-, and p-xylene in California are manufacturers of motor vehicles and equipment, manufacturers of metal cans and shipping containers, and petroleum refining (ARB, 1997b).

B. Emissions

The total emissions of m-, o-, and p-xylene from stationary sources in California are estimated to be at least 30,000 pounds, 34,000 pounds, and 51,000 pounds per year, respectively, based on data reported under the Air Toxics "Hot Spots" Program (AB 2588). In addition, there are also approximately 4 million pounds of unspecified xylenes in addition to those listed individually (ARB, 1997b).

C. Natural Occurrence

m- and p-Xylene occur naturally in petroleum. o-Xylene is found in coal tar, petroleum, forest fires and plant volatiles (Howard, 1990).

AMBIENT CONCENTRATIONS

m-, o-, and p-Xylene are routinely monitored by the statewide Air Resources Board air toxics network. The network's mean concentration of m- and p-xylene from January 1996 through December 1996 is estimated to be 4.17 micrograms per cubic meter ($\mu g/m^3$) or 0.97 parts per billion (ppb). The network's mean concentration of o-xylene, from January 1996 through December 1996, is estimated to be 1.55 $\mu g/m^3$ or 0.36 ppb (ARB, 1997c).

The United States Environmental Protection Agency (U.S. EPA) has also compiled ambient data from 31 study areas throughout the United States on p-xylene from 1985-87. The U.S. EPA reported an overall p-xylene mean concentration of 8.7 $\mu g/m^3$ or 2.0 ppb. The U.S. EPA has also compiled ambient o- and m-xylene data from three study areas throughout the United States from 1989-91. The U.S. EPA reported an overall o-xylene mean concentration of 2.6 $\mu g/m^3$ or 0.6 ppb and an overall m-xylene mean concentration of 5.4 $\mu g/m^3$ or 1.3 ppb (U.S. EPA, 1993a).

INDOOR SOURCES AND CONCENTRATIONS

m-, o-, and p-Xylene are widely used as solvents and are present in numerous consumer products. Consumer products with the highest median emissions of xylenes include pens/inks and coatings. Xylenes are also emitted from building materials such as carpet adhesives, vinyl cove adhesive, latex caulk, latex paint, and various moldings. Environmental tobacco smoke is also a common indoor source of xylenes (Hodgson and Wooley, 1991).

Indoor residential concentrations of m-, p-, and o-xylene have been measured in several studies. The California Total Exposure Assessment Methodology (TEAM) studies were conducted in 1984 and 1987 in and around Los Angeles and Contra Costa County. Because of their physical similarities, m-xylene and p-xylene have been reported as a single value. The mean m- and p-xylene concentrations from these studies ranged from 9.3 to 33.6 $\mu g/m^3$. The mean o-xylene concentrations from these studies ranged from 3.71 to 12.9 $\mu g/m^3$. Indoor values from these studies were consistently higher than outdoor values. The indoor/outdoor ratio was approximately 1.5 to 2.5. (Pelizzari, 1987b; 1989).

In a residential study conducted in Woodland, California m-, p-, and o-xylene were quantifiable in 99 percent of the 125 samples. The indoor average m-, p-xylene concentration was 7.4 $\mu g/m^3$ and the values ranged from below the quantifiable level of 0.35 to 120 $\mu g/m^3$. The indoor average o-xylene concentration from that study was 3.3 $\mu g/m^3$ and the values ranged from below the quantifiable level of 0.1 to 49 $\mu g/m^3$. The indoor/outdoor ratio of m-, p-, and o-xylene in this study was 4.6 $\mu g/m^3$ (Sheldon et al., 1992).

In-vehicle concentrations of m-, p-, and o-xylene were 2 to 6 times higher than outdoor levels. In southern California, a total xylene average concentration of 32.9 $\mu g/m^3$ and a maximum concentration of 254 $\mu g/m^3$ were measured (Shikiya et al., 1989). In Boston, an average m-, p-xylene of 20.9 $\mu g/m^3$ and a maximum of 74.6 $\mu g/m^3$ were recorded. The average and maximum concentrations of o-xylene during this study were 7.3 $\mu g/m^3$ and 26.1 $\mu g/m^3$, respectively (Chan

et al., 1991b). Similar results were observed in a Raleigh, North Carolina in-vehicle study (Chan et al., 1991a).

Emissions of m-, p- Xylene averaged 299 μg/cigarette in environmental tobacco smoke in a chamber study of six brands of cigarettes popular in California (Daisey et al., 1994). Emissions of o-xylene averaged 67 μg/cigarette in environmental tobacco smoke.

ATMOSPHERIC PERSISTENCE

The atmospheric lifetime of m-xylene is 14 to 15 hours. The atmospheric lifetime of o-xylene is 25 to 26 hours. The atmospheric lifetime of p-xylene is 24 to 25 hours (Kao, 1994).

The reaction products of m-xylene are m-tolualdehyde, m-methyl benzyl nitrate, nitro-m-xylene, dimethylphenols, formaldehyde, glyoxal, and methyl glyoxal. The reaction products of o-xylene are o-tolualdehyde, o-methyl benzyl nitrate, nitro-o-xylene, dimethylphenols, formaldehyde, glyoxal, methyl glyoxal, and biacetyl. The reaction products of p-xylene are p-tolualdehyde, p-methyl benzyl nitrate, nitro-p-xylene, dimethylphenols, formaldehyde, glyoxal, and methyl glyoxal (Kao, 1994).

AB 2588 RISK ASSESSMENT INFORMATION

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics "Hot Spots" Program. Of the risk assessments reviewed as of December 1996, for non-cancer health effects, xylenes contributed to the total hazard index in 46 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1. Xylenes also contributed to the total hazard index in 42 of the approximately 107 risk assessments reporting a total acute hazard index greater than 1 (OEHHA, 1996b).

HEALTH EFFECTS

Probable routes of human exposure to xylenes are inhalation, ingestion, and dermal contact (U.S. EPA, 1994a).

Non-Cancer: Exposure to xylene vapors may cause eye, nose, throat, and respiratory tract irritation. Xylene is a central nervous system depressant. Acute exposure may cause gastrointestinal effects such as nausea, vomiting, and gastric irritation. By analogy to toluene and benzene, xylene is predicted to cause cardiac arrythmias. Exposure may injure the kidneys.

An acute non-cancer Reference Exposure Level (REL) of 4.4×10^3 μg/m^3 and a chronic non-cancer REL of 3×10^2 μg/m^3 are listed for mixed xylenes in the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program, Revised 1992 Risk Assessment Guidelines. The toxicological endpoint considered for acute toxicity is respiratory irritation. The

toxicological endpoints considered for chronic toxicity are the respiratory system and reproductive system including teratogenic and developmental effects (CAPCOA, 1993). The U.S. EPA is currently reviewing the Reference Concentration (RfC) for mixed xylenes, m-, o-, and p-xylenes. The U.S. EPA has established an oral reference dose (RfD) of 2 milligrams per kilogram per day (mg/kg/d) for mixed xylenes based on hyperactivity, decreased body weight, and increased mortality in rats. The provisional RfD for m- and o-xylenes is also 2 mg/kg/d. The U.S. EPA estimates that consumption of this dose or less, over a lifetime, would not likely result in the occurrence of chronic, non-cancer effects. The U.S. EPA has not established an RfD for p-xylenes (U.S. EPA, 1994a).

In mice, rats, and rabbits, inhalation of mixed xylene or one of o-, m-, or p-xylene has resulted in increased post-implantation loss, reduced fetal weight, and other indications of retarded development. Oral exposure at high levels in mice has produced cleft palate and reduced fetal weight (ATSDR, 1993i; IARC, 1989c; HSDB, 1995).

Cancer: No information is available on the carcinogenic effects of mixed xylenes in humans. The U.S. EPA has classified xylene (isomers and mixtures) in Group D: Not classifiable as a carcinogen (U.S. EPA, 1994a). The International Agency for Research on Cancer has classified xylene (isomers and mixtures) in Group 3: Not classifiable as to carcinogenicity (IARC, 1987a).